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Anti-Bacterial and Anti-Fungal Study of Synthesized Cu (II) and Ag (II) Clindamycin Co-Ordination Complex and X-Ray Diffraction, TGA Study

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Abstract: *X-ray diffraction studies have been undertaken using the powder technique to determine lattice parameters, crystal system, crystal lattice intercept, angle etc. X-ray powder diffraction of Cu (II) &Ag (II) metal complexes with Clindamycin shows monoclinic and triclinic systems with various unit cell parameters. The Cu (II) & Ag (II) Clindamycin complexes show a more intense band on the spectrogram it indicates the closed pack position of the atom in the crystal system. Anti-bacterial activity of synthesized drug metal complexes shows considerable activity against bacteria in comparison with standard drug molecules.*

Keywords: Coordination complexes, X-ray diffraction, Anti-microbial etc

I. INTRODUCTION

The co-ordination chemistry and bio-inorganic chemistry is an important branch of inorganic chemistry. The metals required in small quantities for the living system and play important roles biocatalytic process. Now days, the transition as well as main group metal ions are useful in proper functioning of different body parts. Many Metal ions are used in the formation of coordination complexes with different bioligands. e. g. Chlorophyll Hemoglobin, Cytochromes etc. A few negatively, positively charged, and neutral ligand molecules are used to form a stable coordination complex with transition metals. Due to medicinal ability the transition metal complexes have used in the development of metal drugs complexes. Today, cis-platin is one of the most selling anticancer drugs, which was discovered in 1960. Other metal complexes are prepared from copper, gold, gallium, germanium, tin, ruthenium, iridium, and some from trace element which show significant chemotherapeutic activity in the living being [1, 2]. Drug resistance to pathogens is becoming a huge problem worldwide. Nowadays various bacterial diseases which were previously treatable are now untreatable, for example resistant Staphylococcus aureus (resistant to methicillin drug), enterococcus [3] and some other microorganisms have exhibited drug resistance ability of Gram positive and gram-negative species like Escherichia coli, Shigella flexeneri, Pseudomonas aeruginosa, Salmonella typhi, Bacillus etc. So, there is a need to increase the synthesis of new compounds (drugs) having antimicrobial, antioxidant, antifungal, and anti- tubercular activities.

II. EXPERIMENTAL METHODS

Synthesis of $[Cu (L_1)_2(Cl)_2]$. H2O Complexes:

The alkali earth metal drug complexes were synthesized as per the following general literature procedure [4-11]. A 0.002 mol. of a ligand L_1 was dissolved in 10 ml of ethanol. To this solution, a solution of 0.002 mol $Cu (Cl)_2.xH2O$ in 10 ml water, was added drop wise with constant stirring and finally heated under reflux for 4 hrs. on a heating mental at 70°C. The reaction mixture was cooled to room temperature. A fine brown precipitate of the solid complexes formed was filtered off, washed with ethanol-water mixture, and stored in vacuum desiccators over anhydrous calcium chloride.

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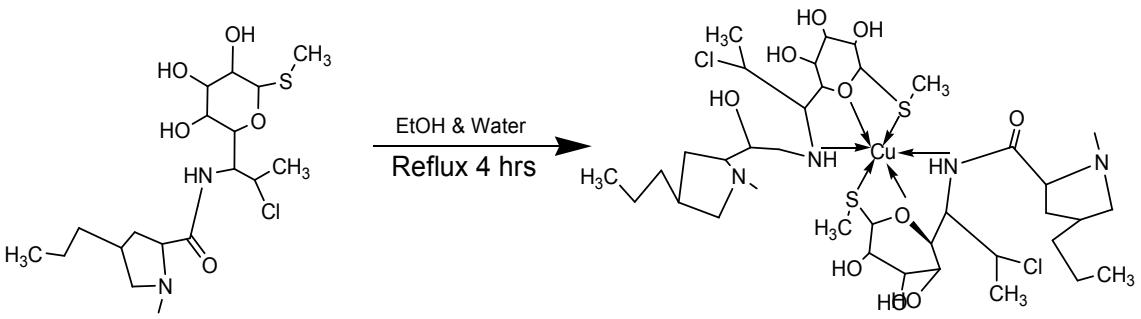

Synthesis of $[Ag\ (L_1)_2(Cl)_2].H_2O$ Complexes:

The alkali earth metal drug complexes were synthesized as per the following general literature procedure [4-11]. A 0.002 mol of a ligand L1 was dissolved in 10 ml of ethanol. To this solution, a solution of 0.002 mol Ag $(Cl)_3$.xH2O in 10 ml water, was added dropwise with constant stirring and finally heated under reflux for 4 hrs. on a heating mental at 70°C. The reaction mixture was cooled to room temperature. A fine sky-blue precipitate of the solid complexes formed was filtered off, washed with an ethanol-water mixture, and stored in vacuum desiccators over anhydrous calcium chloride.

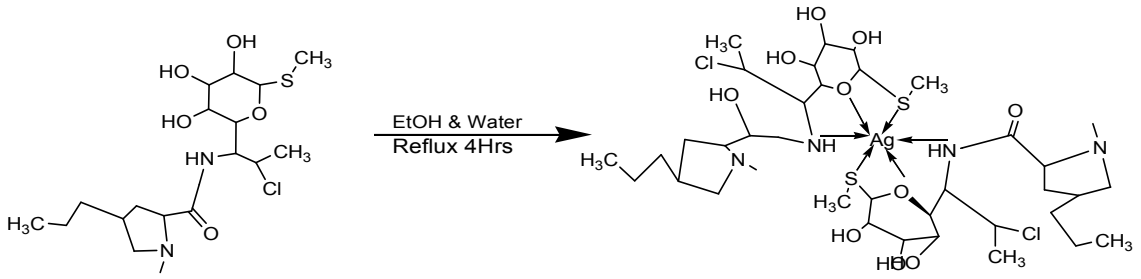

Table No. 01 Physical properties of Clindamycin and its coordination complexes.

Complexes	Molecular Formula	Color of complexes	Physical constant	% Yield
L_1	$C_{18}H_{33}ClN_2O_5S$	Light green	143	-------
ML_1	$(C_{18}H_{33}ClN_2O_5S)_2$ CU	Brown	208	62.7%
ML_1	$(C_{18}H_{33}ClN_2O_5S)_2$ Ag	Blue	211	58.23%

Thermo Gravimetric Analysis

Thermogravimetric and differential thermogravimetric analysis were carried out for the ligand and its corresponding Cu(II), and Ag(II) complexes within the temperature range from ambient temperature to 900°C under N_2 flow. The correlation between the different decomposition steps of Cu(II) complexes with corresponding weight losses is discussed in terms of the proposed formula of the Cu(II)complexes. The water content was determined by the thermogravimetric analysis (TGA). The TGA results showed that the ligand $[L_1]$ is thermally stable in the temperature range of 25 – 223°C. The decomposition starts at 223°C and is completed at 300°C with one decomposition step.

The thermal behavior studies of all the complexes are almost the same. The thermogram of Cu (II) and Ag(II) Clindamycincomplexes are depicted in Figure1 & 2. In the thermogram of Ag(II) complexes, the coordinated water molecules decompose around 103 - 106°C with a weight loss of about 3%, lattice nitrate and coordinated nitrate molecules decomposed in the region 140 - 145°C and 340 - 342°C with a weight loss of about 10.4% and 20.6% respectively.

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Figure: TGA curves of Clindamycin[L1] Coordination complexes with Cu(II) & Ag(II)

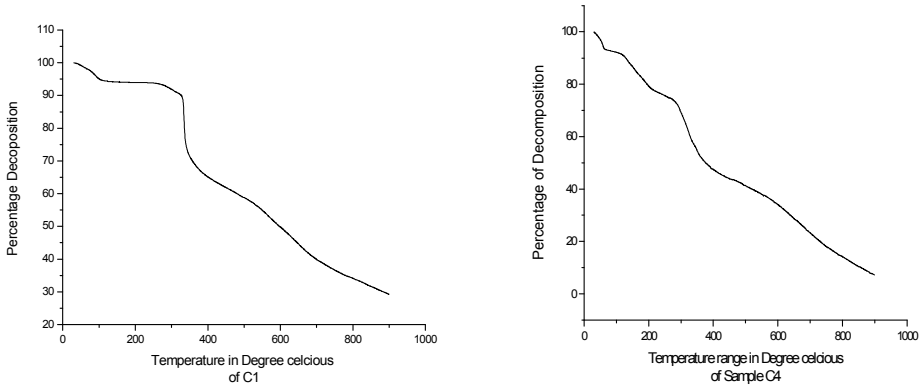


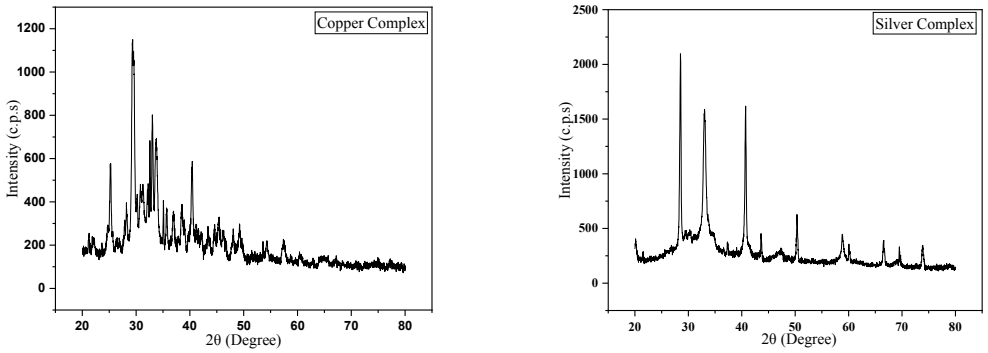
Fig. 1 and 2

XRD data of metal Clindamycin Complex

Powder XRD patterns of all the complexes were recorded over the 2θ = 05-85^0 range. Unit cell parameters were found by usingthe trial-and-error method. Cu(II) and Ag(II) Metal Clindamycin complexes are monoclinic and triclinic with the same and different unit cell parameters respectively [12-19]. The observed unit cell parameters are given in the tableand considering JCPDS software data (a joint committee of powder diffraction standard), and ICDD (International Center of diffractiondata). The powder XRD patterns are shown in the figure

Table No. 02 Unit cell parameters of Clindamycinmetal complexes: -

Compounds	Lattice constant			α(A^0)	β(A^0)	ϒ(A^0)	2Θ	D value	Crystal system
	a(A^0)	b(A^0)	c(A^0)						
$(C_{18}H_{33}ClN_2O_5S)_2$ Cu	6.82	9.23	8.83	90	109	90	7.34	8.95	Monoclinic
$(C_{18}H_{33}ClN_2O_5S)_2$ Ag	9.31	7.4	8.8	105.4	97.7	101.9	8.42	6.67	Triclinic



Anti-microbial Activity

The antibacterial and antifungal activity of Drugs and their metal complexes are described in this chapter. Both activities are studied by MIC (minimum inhibitory concentrations) and disc diffusion method (Kirby Bauer disk diffusion method) and their finding are compared with the standard drug which is used as a ligand in complex formation. It is divided into two sections.

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Section first includes an introduction to fungi, ***Aspergillus niger*** and ***Candida albicans***. **Section second** includes an experimental procedure of measurement of antibacterial activity of ligands and their metal complexes in vitro against gram-negative bacteria ***Pseudomonas aeruginosa, E. coli, Proteus vulgaris*****and gram-positive bacteria*** ***Streptococcus pneumoniae*** by disc diffusion method (Kirby Bauer disk diffusion method

Anti-fungal and Anti-microbial activity of Clindamycin Cu(II) and Ag(II) complexes: -

01. Anti-fungal activity of Clindamycin metal complexes: -

Anti-fungal activity of Chloroquine Cu(II) and Ag(II), complexes show very good activity against *Aspergillus niger* and *Candida albicans.* All Clindamycin metal complexes showa higher zone of inhibition as compared to the slandered Clindamycin. Ag(II) Chloroquine complex shows higher antifungal activity against*Aspergillus nigerand Candida albicans*as compared to other complexes. Anti-fungal activity ofcomplexes increases with an increase in concentration of complexes but over this, all complexes are more potent than that of standard drug. Anti-fungal activity of complexes is given in **Table No. 03.**

Complexes	***Aspergillus niger***				***Candida albicans***			
	250 ppm	500 ppm	1000 ppm	2000 ppm	250 ppm	500 ppm	1000 ppm	2000 ppm
$[Cu(L)_2(H2O)_2]Cl_2$	**9**	**14**	**17**	**24**	**3**	**10**	**12**	**19**
$[Ni(L)_2(H2O)_2]Cl_2$	**7**	**15**	**19**	**22**	**8**	**11**	**15**	**17**
Clindamycin	**4**	**9**	**13**	**19**	**6**	**10**	**12**	**18**

Table 03: Antifungal activity of metal Clindamycin complexes.

Antibacterial activity of metal Clindamycin complexes

Anti-bacterial activity of Chloroquine Cu(II) and Ag(II)complexes shows very good activity against bacterial species compared to the standard Clindamycin drug[20-27]. In synthesized complexes,the Cu(II) complex shows a high zone of inhibition against *E. coli*, Cu(II)complex givesa high number zone of inhibition against *Streptococcus pneumoniae*, whereas Ag(II) complexes showa high zone of inhibition against *Pseudomonas aeruginosa, Proteus vulgaris.*

Bacterial species	$(C_{18}H_{33}ClN_2O_5S)_2$ CU				$(C_{18}H_{33}ClN_2O_5S)_2$ Ag				Clindamycin 500 ppm
	250 ppm	500 ppm	1000 ppm	2000 ppm	250 ppm	500 ppm	1000 ppm	2000 ppm	
Pseudomonas aeruginosa	**6**	**13**	**15**	**19**	**9**	**10**	**21**	**22**	**8**
E. coli	**5**	**12**	**19**	**24**	**7**	**11**	**19**	**26**	**7**
Proteus vulgaris	**4**	**11**	**14**	**21**	**8**	**13**	**17**	**29**	**9**
Streptococcus pneumoniae	**7**	**10**	**16**	**22**	**10**	**14**	**21**	**27**	**6**

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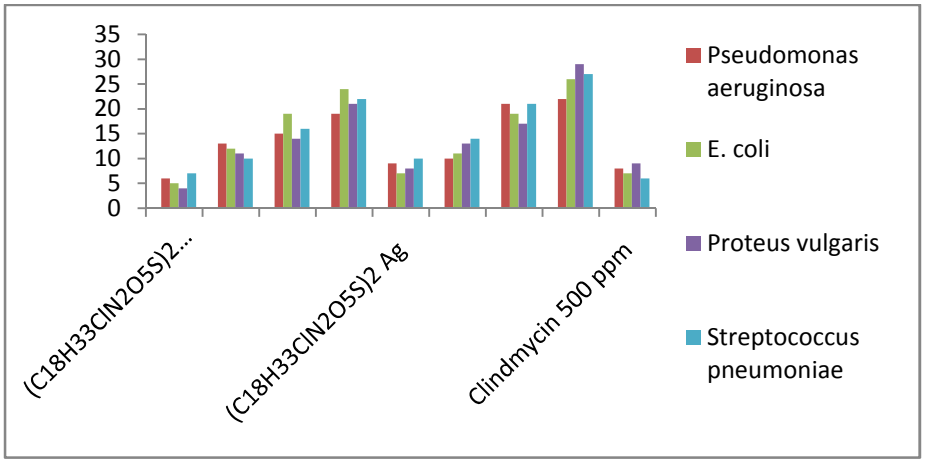

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